USER MANUAL

Laser Compensation

Laser Compensation Software

3AO-LASERC-xUxx

October 22, 2003

DELTA TAU
Data Systems, Inc.
NEW IDEAS IN MOTION ...

Single Source Machine Control *Power // Flexibility // Ease of Use*
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INTRODUCTION

Laser Compensation using PMAC is now faster and more accurate in comparison to the conventional way.

The typical laser compensation process is time consuming and error prone, because motion must be stopped to take the laser reading. This affects machine response and allows human error.

The Automatic Laser Compensation program eliminates most of the common errors. The readings are taken on the fly and it calculates the Leadscrew and Backlash tables and then automatically downloads it to PMAC.

With Manual Laser Compensation, the tables can be created and edited before downloading to PMAC.

Concept

The laser calibration program relies in the position compare and position capture feature of the PMAC motion controller. The motor under calibration uses the position compare to activate the EQU output signal at regular position intervals. This output triggers the position capture of the laser interferometer, which is read through an independent spare encoder channel. This technique, based on a highly precise hardware-controlled feature, allows creating a compensation table for each motor.

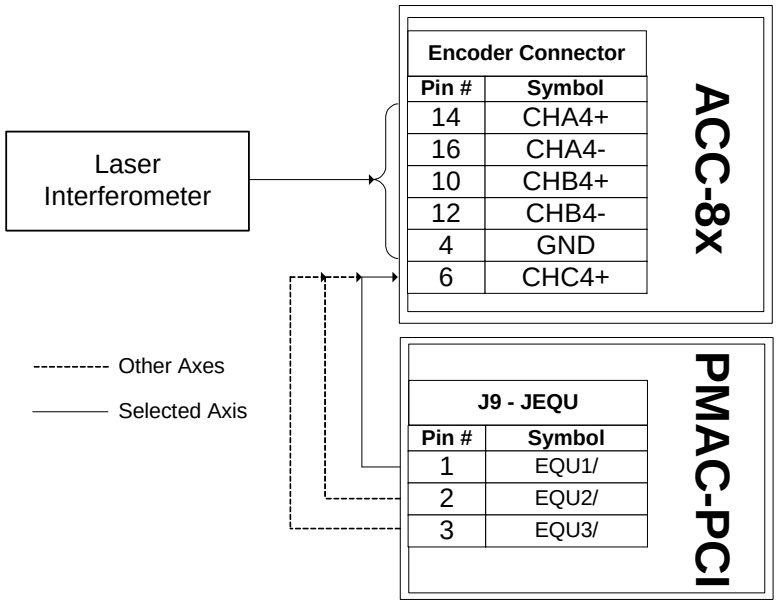
In general, a spare encoder input is used to connect the laser interferometer quadrature encoder. In case no spare encoder input is available, an encoder input of a motor that is not currently being calibrated could be used temporarily. For a typical NC 4-axis machine, the Spindle channel can be used as a free channel. Then, the corresponding EQU line output that belongs to the motor under calibration is connected to the C channel input of the encoder channel used to connect the laser interferometer. The following examples show the connections for the most commonly used Delta Tau motion controllers. In PMAC boards, the JEQU connector is a 10-pin male header. In the UMAC accessories ACC-24E2x, the JEQU connector is a 3-pin terminal.

Note:

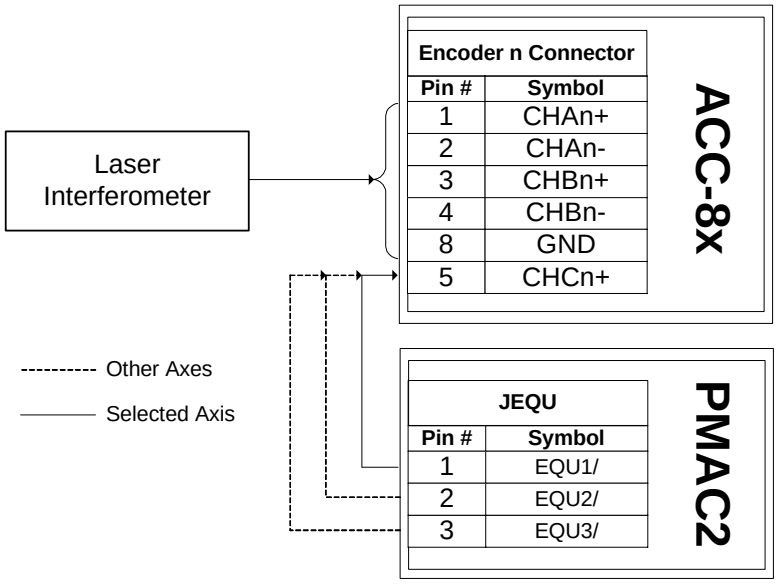
The indicated connections must be made every time an axis is selected for compensation.

Board Name	Type of Connector on PMAC or UMAC
PMAC-Lite PCI	J8 10 Pin Header
PMAC1-PCI	J9 10 Pin Header
PMAC2-Lite PCI	J8 10 Pin Header
PMAC2-PCI	J8 10 Pin Header
Turbo PMAC-PCI	J9 10 Pin Header
UMAC	TB3 top OR J1 (15 Pin DB male connector) top FOR DB option

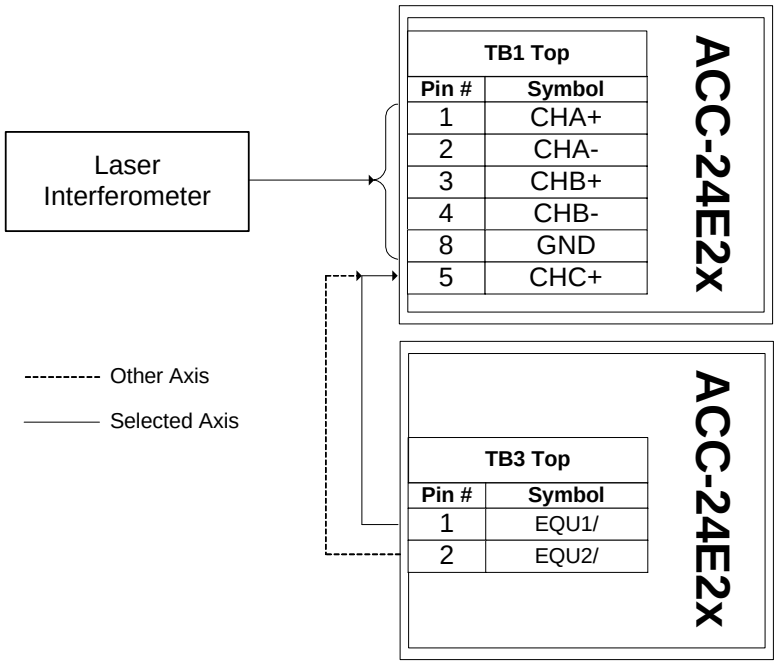
Example: A PMAC-PCI board is used. Encoder channel #4 is used to connect the laser interferometer quadrature encoder. Motor #1 uses the encoder compare feature, triggering the EQU1/ at regular position intervals. The accessory board shown can be an ACC-8D, ACC-8P or any other breakout accessory board compatible with a PMAC board.



Example: A PMAC2 board is used. Any spare encoder channel can be used to connect the laser interferometer quadrature encoder. Motor #1 uses the encoder compare feature, triggering the EQU1/ at regular position intervals. The accessory board shown can be an ACC-8E, ACC-8F or any other axis interface board compatible with a PMAC2 board.



Example: A UMAC System is used. Any spare encoder channel can be used to connect the laser interferometer quadrature encoder. Motor #1 uses the encoder compare feature, triggering the BEQU1 at regular position intervals. The accessory board shown can be an ACC-24E2, ACC-24E2A or any other UMAC axis interface board with quadrature encoder inputs.



Requirements

Automatic Laser Compensation

The following items are needed to run the Automatic Laser Program:

- Laser with A QUAD B output (not necessary for Manual Mode)
- Delta Tau's Automatic Laser Compensation Program (Window's 98, 2000, or NT operating system)
- Delta Tau's Turbo PMAC1/2 or PMAC1/2
- Interfacing Cables
- Executive PRO Software to communicate with PMAC

Laser Compensation Installation

After the successful default installation, the directory structure will look like:

```
C:\ Program Files \ Delta Tau \ Laser Compensation \ Laser_comp.exe
C:\ Program Files \ Common Files \ Delta Tau Shared \ Lasercompdef.h
```

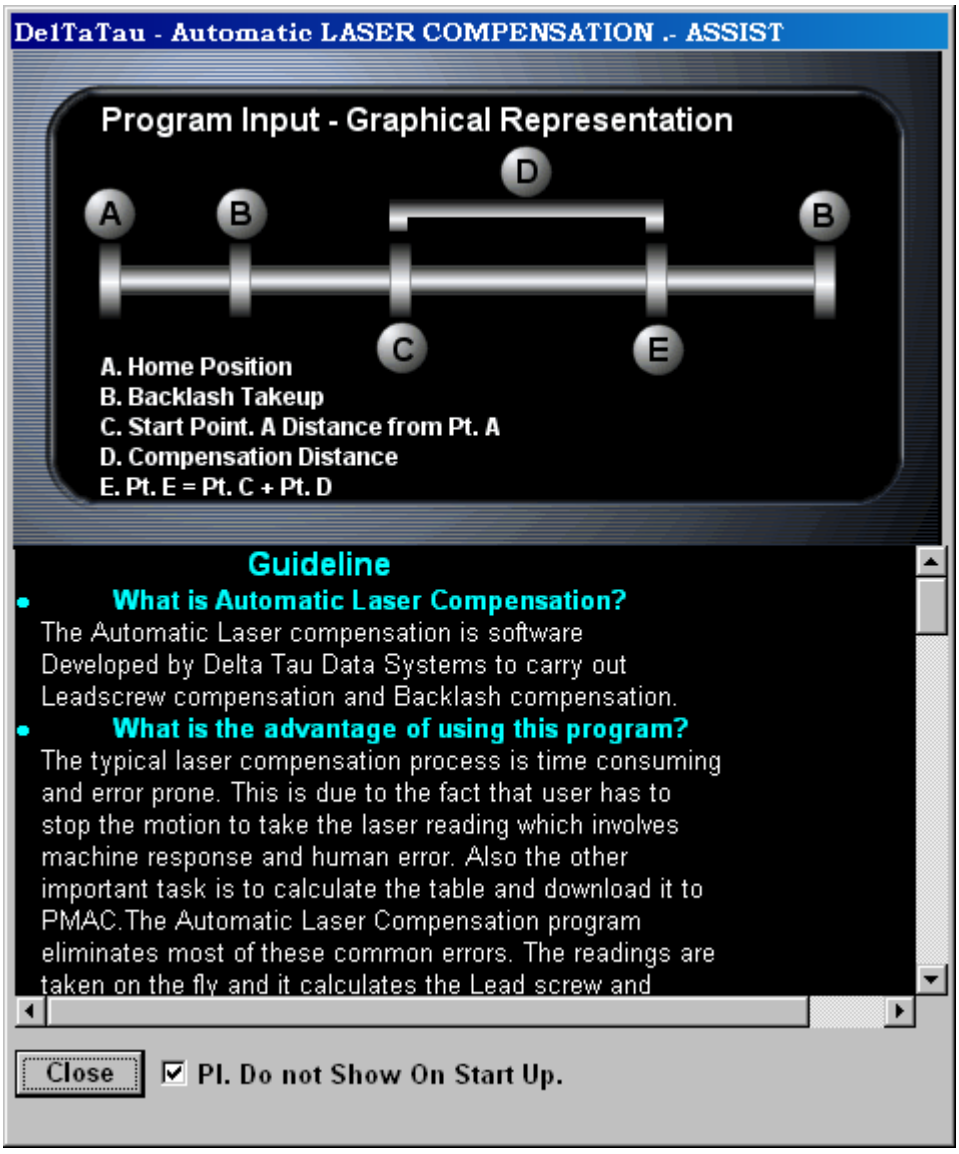
Online Assist for Quick Start

This function is available in Automatic Laser Compensation only.

When the program is started, the main screen displays along with the Assist screen. The assist screen provides quick help for those who want to use the application without the detailed manual.

The Assist screen consists of two sections. The first section outlines the steps to set up the Program Input and the second explains the meaning of the programming parameters with the help of diagram.

Click **Pl Do not show on Start up** to prevent the display of the Assist screen at the start of the application.


DelTaTau - Automatic LASER COMPENSATION .- ASSIST
Program Input - Graphical Representation
A
B
D
B
C
E
A. Home Position
B. Backlash Takeup
C. Start Point. A Distance from Pt. A
D. Compensation Distance
E. Pt. E = Pt. C + Pt. D
Guideline
What is Automatic Laser Compensation?
The Automatic Laser compensation is software
Developed by Delta Tau Data Systems to carry out
Leadscrew compensation and Backlash compensation.
What is the advantage of using this program?
The typical laser compensation process is time consuming
and error prone. This is due to the fact that user has to
stop the motion to take the laser reading which involves
machine response and human error. Also the other
important task is to calculate the table and download it to
PMAC.The Automatic Laser Compensation program
eliminates most of these common errors. The readings are
taken on the fly and it calculates the Lead screw and
Close
Pl. Do not Show On Start Up.

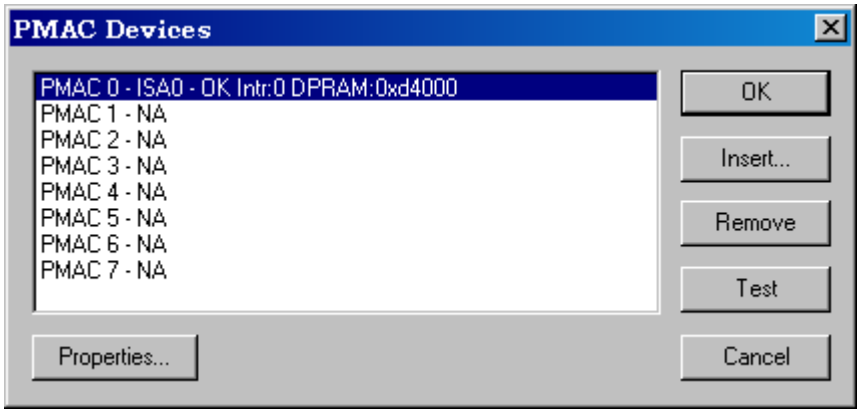
PROGRAM SETUP

Set up the program as follows:

1. Start the application by typing **LASER.EXE.**

   At the start of the program, the Welcome screen displays.

2. Select the type of the compensation, either **Automatic** or **Manual**, and then click the **Continue** button. The PMAC Device Dialog Box displays.



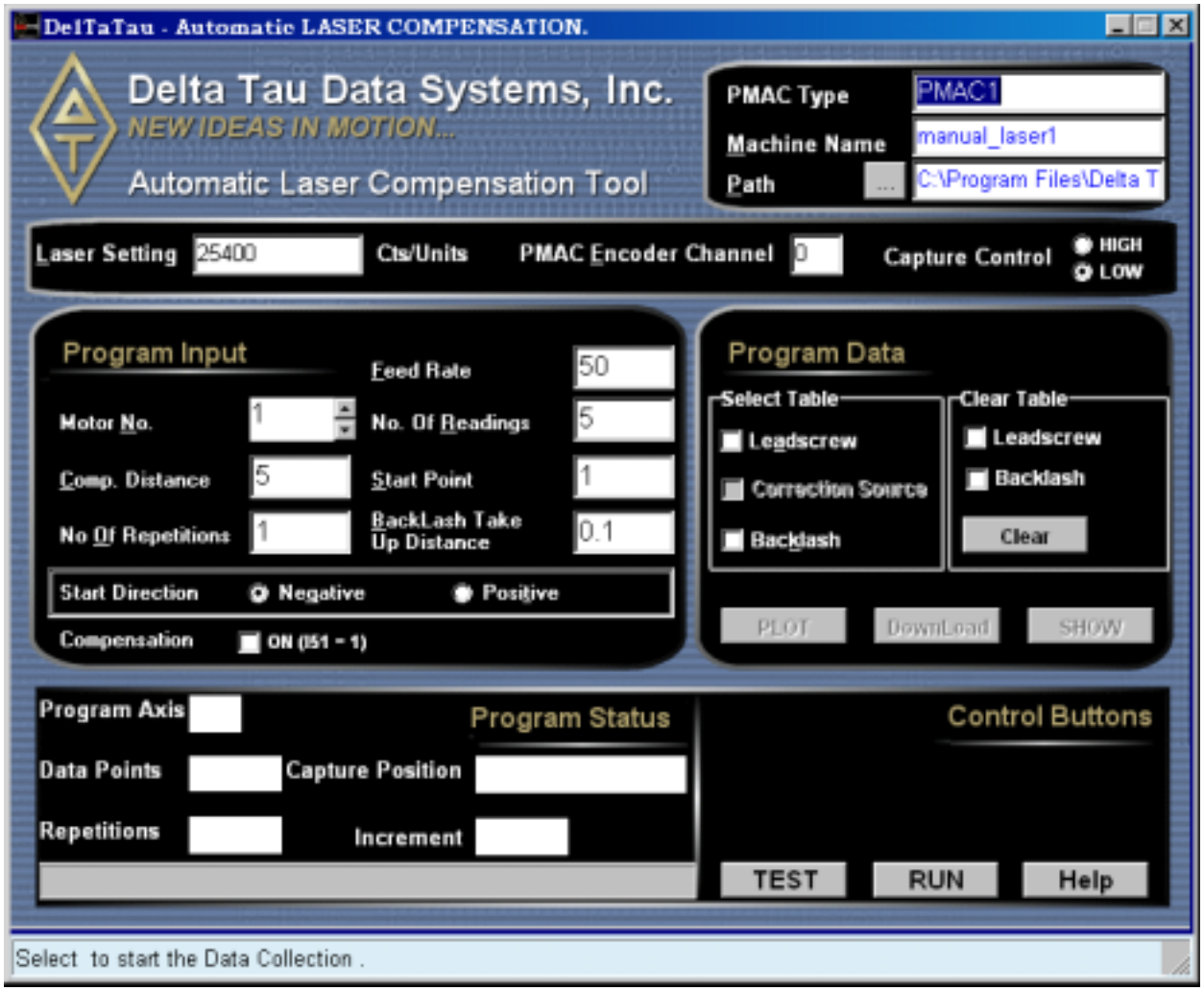
3. Select the appropriate device and click **OK**. The Laser Compensation dialog box displays. See the Main Screen section of this manual to proceed.

AUTOMATIC LASER COMPENSATION EXECUTION

Main Screen

Highlights

- Navigate the input by pressing **Tab**, or directly select the input by pressing **Alt** and the underlined letter.
- Single line help is available when the focus is set to the input field.
- Run time status displays in the Program Status group box.



Fields

The following outlines the different fields on the main screen.

PMAC Type: This will detect and display the PMAC type automatically. This input cannot be altered. If there is no PMAC, then the default PMAC type will be Turbo PMAC 2.

Machine Name: Enter a specific folder name for the application here, if desired. All the files created by the application are stored in this folder. The change can be observed in the Path input. The default name is MyLaser.

Path: The default path to create the Machine Name folder is C:\Program Files \ Delta Tau \<Machine Name>. Browse to change the default path.

Laser Setting: This important setting comes from the Laser manufacturer. This setting specifies the number of counts per unit of distance traveled. The Laser is required to have A QUAD B output. A typical method for calculating the number of pulses is 1/LAMBDA where LAMBDA is the wavelength of the laser.

PMAC Encoder Channel: This input specifies the PMAC channel used to connect Laser A QUAD B output. Usually, this is a free channel on PMAC. For the 4-axes system, the spindle encoder connection can be replaced by Laser A QUAD B connection.

Program Input Section:

Motor No: Specify the motor number selected for compensation.

Comp Distance: Specify the compensation distance from the Start point. The laser reading will be taken on the fly over this distance. Set this distance so that Start Point + comp distance is not greater than total travel available on the machine, otherwise the machine limits will generate fault.

No. of Repetitions: This field specifies the repetitions of readings. Multiple readings improve statistical validity of the measurements. Three is a good statistical value. The maximum value is 10.

Feed Rate: Enter the feedrate at which the selected motor will move in units per minute.

No of Readings: Enter the number of intervals at which the laser reading will be taken. For the Turbo PMAC, this limit is 500 points and for Non-Turbo, it is 200.

Start Point: Enter the absolute distance from Home position. The compensation readings will start from this point and end at Start Point + comp Distance. This value should be large enough to accommodate Backlash Take up distance.

Backlash Take Up Distance: This field specifies the distance from the start point to move so that motor motion will get rid of the backlash and backlash will not affect the first reading. This value should not be set to a value greater then zero.

Start Direction: This is the direction of the motion. Normally this is opposite of the Homing direction.

Compensation: This value differentiates between the creation of the table and the verification of the table. Normally, this checkbox is not clicked the first time the program is run, so that the compensation readings will accurate. This box can be checked after the data is collected and tables are downloaded to PMAC. This is for the verification of the compensation table. The box will be checked automatically on table download.

Program Status: This group of boxes represents the parameters, which are displayed during the data collection run.

Program Axis: This field shows the axis associated with the input motor number.

Data Points: This is the current number of the reading.

Capture Position: This is current data captured on the fly.

Repetitions: This is the current repetition number.

Increment: This increment field (Comp Distance/ No of readings) displays the trigger distance at which data will be captured on the fly.

Program Data: This group of boxes represents the input set usually after the first data collection run.

Select Table: This group of boxes represents the type of table to be created for the selected motor.

Lead screw: Click to generate the Lead screw compensation table when the download key is clicked.

Correction Source:

Backlash: Click to generate the Backlash compensation table when the download key is clicked.

Clear Table: This group of boxes represents the type of table to be deleted from PMAC for the selected motor.

Leadscrew: Click to delete the Lead screw table on Clear key.

Backlash: Click to delete the Backlash table on Clear key.

Plot: Selecting this button will plot the current captured data. The plot can be re-scaled.

Download: Selecting this button will generate the selected comp tables from the select table and those tables will be downloaded to PMAC. After download, this button will be grayed out until one data collection cycle executes.

Show: Clicking this button will display the current data in tabular form.

Control Buttons Section:

Run: Click this button to start the motion program to capture data on the fly.

Test: Click this button to match the encoder counting direction of selected axis and the laser axis. The encoder counting direction for the selected axis and laser (A QUAD B) encoder counting direction must be the same.

Help: Click this button to get Online Quick Help to explain the Program Input.

File Management

The following files are generated from this application in the Path \ Machine Name folder.

Axis<Motor No>_comp.pmc -: Lead screw compensation file for the motor number (e.g. Axis1_comp.pmc).

Axis<Motor No>_blcomp.pmc -: Backlash compensation file for the motor number (e.g. Axis1_blcomp.pmc).

<Axis Char>_comp_<repeat counter>.txt -: Data collection file (e.g. X_comp_1.txt).

<Axis Char>_RMS_<Motor No>.txt -: Tabular data display file (e.g. X_RMS_1.pmc).

Laser_comp.pmc and Laser_comp.plc are the motion program and plc files used in the application.

Executing Automatic Laser Compensation

To execute the automatic program, use the following seven steps:

1. Clear all tables.
2. Set Program Input group.
3. Start data collection.
4. Select type of compensation and download.
5. Verify backlash compensation.
6. Select type of compensation and download.
7. Verify leadscrew and backlash compensation.

Step 1

Clear all the tables from the PMAC by selecting tables in the **Clear Table** group and clicking the **Clear** button.

Step 2

Set **Program Input** group.

1. The compensation is for **Motor No** 1 at 100 inch/Min **Feed Rate**.
2. The distance to be compensated is (**Comp. Distance)** 16 inches and **No. Of Readings** are 16. Thus the readings are taken at every inch.
3. The first data point is at 1 inch (**Start Point**).
4. The data will be collected for 3 cycles (**No. Of Repetitions**) and direction of the motion is Negative.

All the output files are stored under C:\Program Files\Delta Tau\HAAS folder.

Step 3

Click the **Run** key to start data collection. This will generate the following motion program and PLC.

Motion Program Generated for the HAAS Machine

This Program is designed to process the Automatic Position Compare - Capture for leadscrew compensation. Include the LaserCompDef.h file.

```
DATA_READY_2_UPLOAD = 0
FEED_RATE = 50
P_WIDTH =2
COMP_REPETATIONS = 3
COMP_DISTANCE = 16.0000
NO_OF_READINGS = 16
START_DISTANCE = 1.0000
START_DIRECTION = -1
BACKLASH_DISTANCE = 0.1000
Direction1 =0
Direction2 =0
I51 = 0
Comp1_correction = 0
Q1000..2999 = 0
I186 = 0
I185 = 0
Ix86_constant = 0
```

```
OPEN PROGRAM 100
CLEAR
TEMP1 = LKHD_MODE
LKHD_MODE = 0
TEMP2 = ACC_TIME_TA
ERROR_NUMBER = 0
Pointer_to_P_Base =2000
ENC1_COMP_A_M = ENC1_COUNTER_M + (30 *138714.3987 * START_DIRECTION)
ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * START_DIRECTION)
IF (ENC1_COMP_A_M > 16777200)
  ENC1_COMP_A_M =16777200 * START_DIRECTION
  ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * START_DIRECTION)
ENDIF
START_L_SCREW_COMP = 0
DATA_READY_2_UPLOAD = 0
Program_End = 0
CMD "EQU1_COMPARE_OUTPUT_M = 0 ENC1_COMP_LATCH_CNTL_M = 1"
```

```
DWELL200
P2000 = ENC7_CAPTURE_M
P2000= 0
CMD "DIS PLCC0"
CMD "ENA PLCC0"
INCREMENT = 0
ENC1_COMP_ATINCR_M = 0
IF (HOME_COMPLETE_1_M = 0)
  ERROR_NUMBER = 1
  GOTO 1
ENDIF
TEMP4 = COMP_DISTANCE/NO_OF_READINGS
INCREMENT = TEMP4 *138714.3987
TEMP5 = NO_OF_READINGS
TEMP8 = COMP_REPETATIONS
Pointer_to_Q1000 = 1000
Pointer_to_Q2000 = 2000
TA(100)
Feed1 = (FEED_RATE * 30) /100
LINEAR
ABS
F(Feed1)
X(START_DISTANCE * START_DIRECTION)
DWELL200
WHILE (IN_POSITION_M = 0 OR DES_VEL_ZERO_1_M=0)
ENDWHILE
DWELL1000
INC
X(START_DIRECTION * -1 * BACKLASH_DISTANCE )
DWELL1000
WHILE (IN_POSITION_M = 0 OR DES_VEL_ZERO_1_M=0)
ENDWHILE
DWELL1000
  WHILE (TEMP8 != 0)
       Pointer_to_P_Base = 2000
       TEMP3 = START_DIRECTION
       Incremental_counter =INCREMENT
       ENC1_COMP_A_M      =      ENC1_COUNTER_M      +(BACKLASH_DISTANCE      *
138714.3987*START_DIRECTION) + Q1000_Pointer+Ix86_constant+Q2000_Pointer
       ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * START_DIRECTION)
       CMD "EQU1_COMPARE_OUTPUT_M = 0 ENC1_COMP_LATCH_CNTL_M = 1"
       Pointer_to_Q1000=Pointer_to_Q1000+1
       Pointer_to_Q2000 = Pointer_to_Q2000+1
       First_Data_POINT  =  ENC1_COUNTER_M  +  (BACKLASH_DISTANCE  *138714.3987  *
START_DIRECTION)
       DWELL200
       Direction1 = 1
       START_L_SCREW_COMP = 1
       Pos_Reading_Counter = 0
       INC
       F(FEED_RATE)
       X((COMP_DISTANCE     +     BACKLASH_DISTANCE+     BACKLASH_DISTANCE)     *
START_DIRECTION)
       DWELL200
       WHILE (IN_POSITION_M = 0 OR DES_VEL_ZERO_1_M=0)
       ENDWHILE
       WHILE (Direction1 = 1)
```

```
        ENDWHILE
        START_L_SCREW_COMP = 0
        TEMP3 = TEMP3 * -1
        ENC1_COMP_A_M = ENC1_COUNTER_M +(30 * 138714.3987 * TEMP3)
        ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * TEMP3)
        IF (ENC1_COMP_A_M > 16777200)
          ENC1_COMP_A_M =16777200 * TEMP3
          ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * TEMP3)
        ENDIF
        ENC1_COMP_A_M   =   First_Data_POINT   -(Incremental_counter   *   TEMP3)   +
Q1000_Pointer
        ENC1_COMP_B_M = ENC1_COMP_A_M - (P_WIDTH * TEMP3)
        CMD "EQU1_COMPARE_OUTPUT_M = 0 ENC1_COMP_LATCH_CNTL_M = 1"
        DWELL200
        Direction2 = 1
        START_L_SCREW_COMP = 1
        Pos_Reading_Counter = 0
        F(FEED_RATE)
        X((Comp_Distance+Backlash_Distance+Backlash_Distance) * Start_Direction*
-1)
        DWELL200
        WHILE (IN_POSITION_M = 0 OR DES_VEL_ZERO_1_M=0)
        ENDWHILE
        WHILE (Direction2 = 1)
        ENDWHILE
        START_L_SCREW_COMP = 0
        TEMP8=TEMP8 - 1
        CAPTURE_AT_HOME = P2000
        DATA_READY_2_UPLOAD = 1
        DWELL750
        ENC1_COMP_A_M = ENC1_COUNTER_M + (30 *138714.3987 * START_DIRECTION)
        ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * START_DIRECTION)
        IF (ENC1_COMP_A_M > 16777200)
          ENC1_COMP_A_M =16777200 * START_DIRECTION
          ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * START_DIRECTION)
        ENDIF
        WHILE (DATA_READY_2_UPLOAD = 1)
        ENDWHILE
        CMD "EQU1_COMPARE_OUTPUT_M = 0 ENC1_COMP_LATCH_CNTL_M = 1"
        DWELL200
  ENDWHILE
N1
TEMP8 = COMP_REPETATIONS
LKHD_MODE = TEMP1
Program_End = 1
TA(TEMP2)
ACC_TIME_TA  = TEMP2
CLOSE
```

PLCC Generated for the HAAS Machine

This is a PLCC0 for reading the COMPARE data on the fly for leadscrew compensation. Include the LaserCompDef.h file.

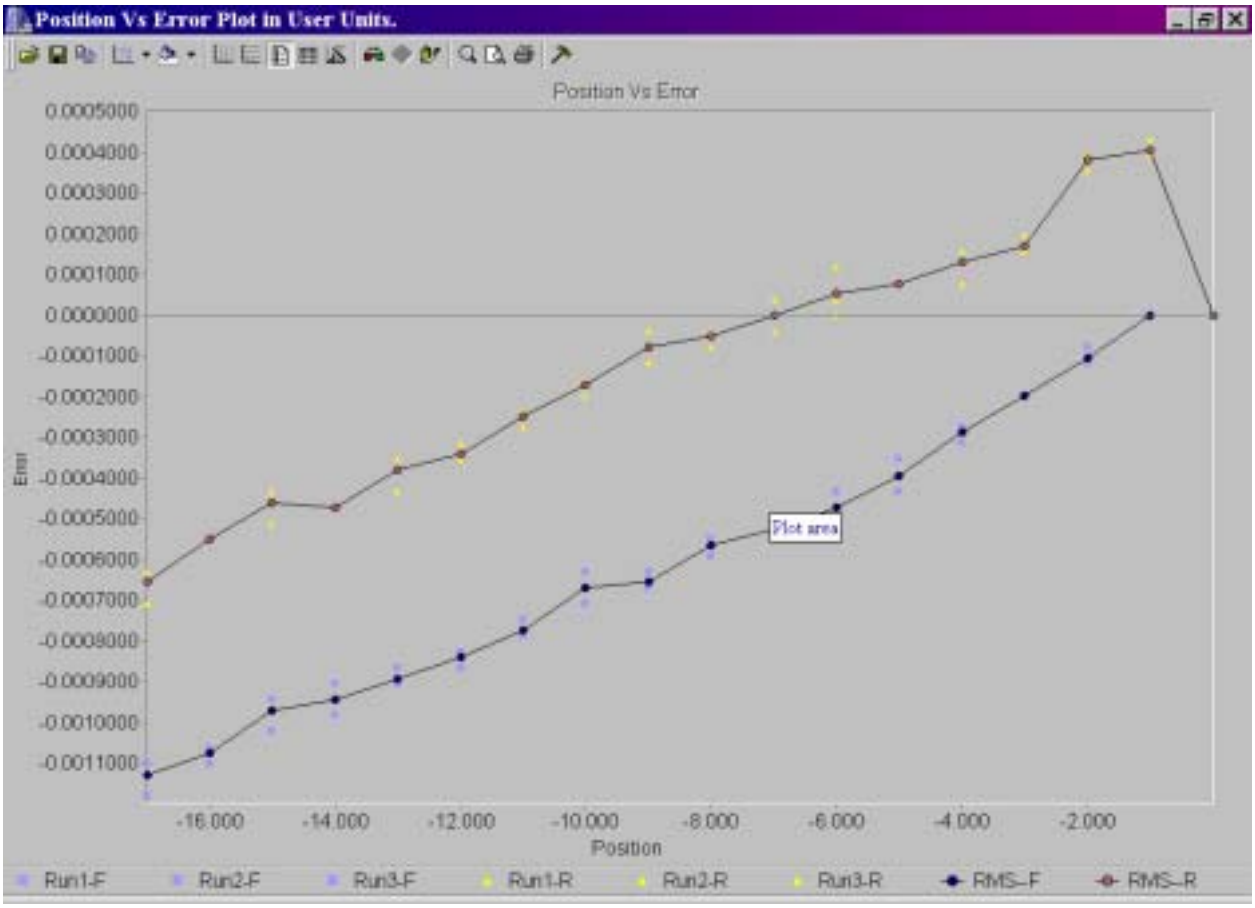
```
Pointer_to_P_Base =2000
Current_Capture_Pos = 0
I7132 = 13

OPEN PLCC 0 CLEAR
```

```
WHILE (START_L_SCREW_COMP =1)
  IF (Direction1 = 1)
    IF (ENC1_COUNTER_M < ENC1_COMP_B_M)
       P_Base_Pointer = ENC7_CAPTURE_M
       Current_Capture_Pos =ENC7_CAPTURE_M
       Pointer_to_P_Base = Pointer_to_P_Base +1
       Pos_Reading_Counter = Pos_Reading_Counter + 1
       IF (Pos_Reading_Counter =17)
         Direction1 = 0
         Pointer_to_Q1000 =1000 + NO_OF_READINGS
         Pointer_to_Q2000 = 2000
       ELSE
         Incremental_counter = INCREMENT * Pos_Reading_Counter
         ENC1_COMP_A_M = First_Data_POINT + (Incremental_counter *
TEMP3)+Q(Pointer_to_Q1000)+Ix86_constant+Q(Pointer_to_Q2000)
         ENC1_COMP_B_M = ENC1_COMP_A_M + (P_WIDTH * TEMP3)
         Pointer_to_Q1000 = Pointer_to_Q1000 + 1
         Pointer_to_Q2000 = Pointer_to_Q2000 + 1
       ENDIF
    ENDIF
  ENDIF
  IF (Direction2 = 1)
    IF (ENC1_COUNTER_M > ENC1_COMP_B_M)
      P_Base_Pointer = ENC7_CAPTURE_M
      Current_Capture_Pos =ENC7_CAPTURE_M
      Pointer_to_P_Base = Pointer_to_P_Base +1
      Pos_Reading_Counter = Pos_Reading_Counter + 1
      IF (Pos_Reading_Counter =17)
        Direction2 = 0
        Pointer_to_Q1000 = 1000
        Incremental_counter = INCREMENT
      ELSE
        Incremental_counter = Incremental_counter - INCREMENT
        Pointer_to_Q1000 = Pointer_to_Q1000 -1
        ENC1_COMP_A_M = First_Data_POINT - (Incremental_counter *
TEMP3)+Q(Pointer_to_Q1000)
        ENC1_COMP_B_M = ENC1_COMP_A_M - (P_WIDTH * TEMP3)
      ENDIF
    ENDIF
  ENDIF
ENDWHILE
CLOSE
```

On completion of motion, **Program End** will display. At this point, the **Show Data, Plot Data** and **Download** functions are enabled from the **Program Data** group.

Click **Plot Data** to display the **Position Vs Error** plot for the current run.



The points in blue are the points collected in Forward Run and the points in yellow are the points collected in Reverse Run. The dark blue and red points are the average of Forward and Reverse run.

Note:

There is an extra point in reverse run at (0,0). This is not a true point data collected point. This point is for the reference.

Step 4

Select the type of compensation from **Select Table** Group and click the **Download** button. This will generate and download the selected table. In the example, the Backlash table is selected first. On completion of download, **Comp Table ON** will be checked true.

Note:

It is not necessary to select the tables one at a time. This is just an example to show the effect of compensation.

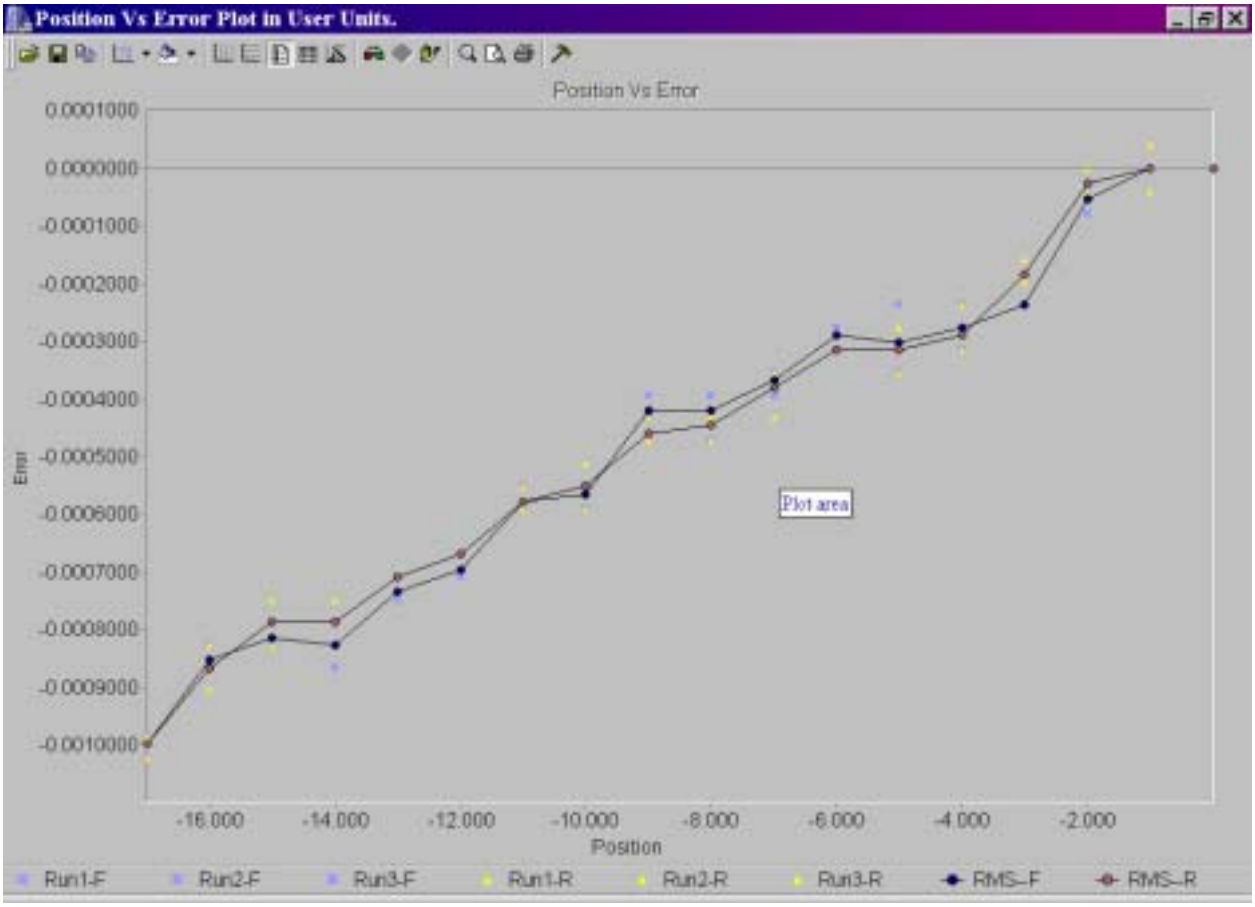
Step 5

Click **Run** to verify the backlash compensation. The motion program will be executed and data will be collected. On completion, **Program End** will display. At this point, select **Plot Data.**

The plot on the following window shows the effect of the backlash compensation. The forward and reverse data points are very close to each other. Compare this plot with that of the previous window.

Note:

There is an extra point in reverse run at (0,0). This is not a true data collected point. This point is for reference.



A typical Backlash table generated from the program will look like:

```
//-----------------------------------------------------------------
//    BackLash Table
//-----------------------------------------------------------------
//   Machine Name : HAAS     Pmac Type : PMAC_TURBO2
//   File Path : C:\Program Files\Delta Tau\HAAS\Axis1_BLCOMP.PMC
//------------------------------Backlash Table Definition------------------
#1 DEF BLCOMP  18  2496859
//--------------------Backlash Table-------------------
-145
-262
-232
-145
-232
```

```
-203
-262
-203
-378
-233
-262
-262
-145
-29
87
-174
0
0
//--------------------Backlash count-------------------
I186 = -902
```

Step 6

Select the type of compensation from the **Select Table** Group and click the **Download** button. This will generate and download the selected table. In the example, the Backlash table was selected in step four, so now select Leadscrew Compensation. (Deselect Backlash if PMAC Firmware is less than 1.937 for Turbo or 1.16G for PMAC 1 / 2). On completion of Download, **Comp Table ON** will be checked true.

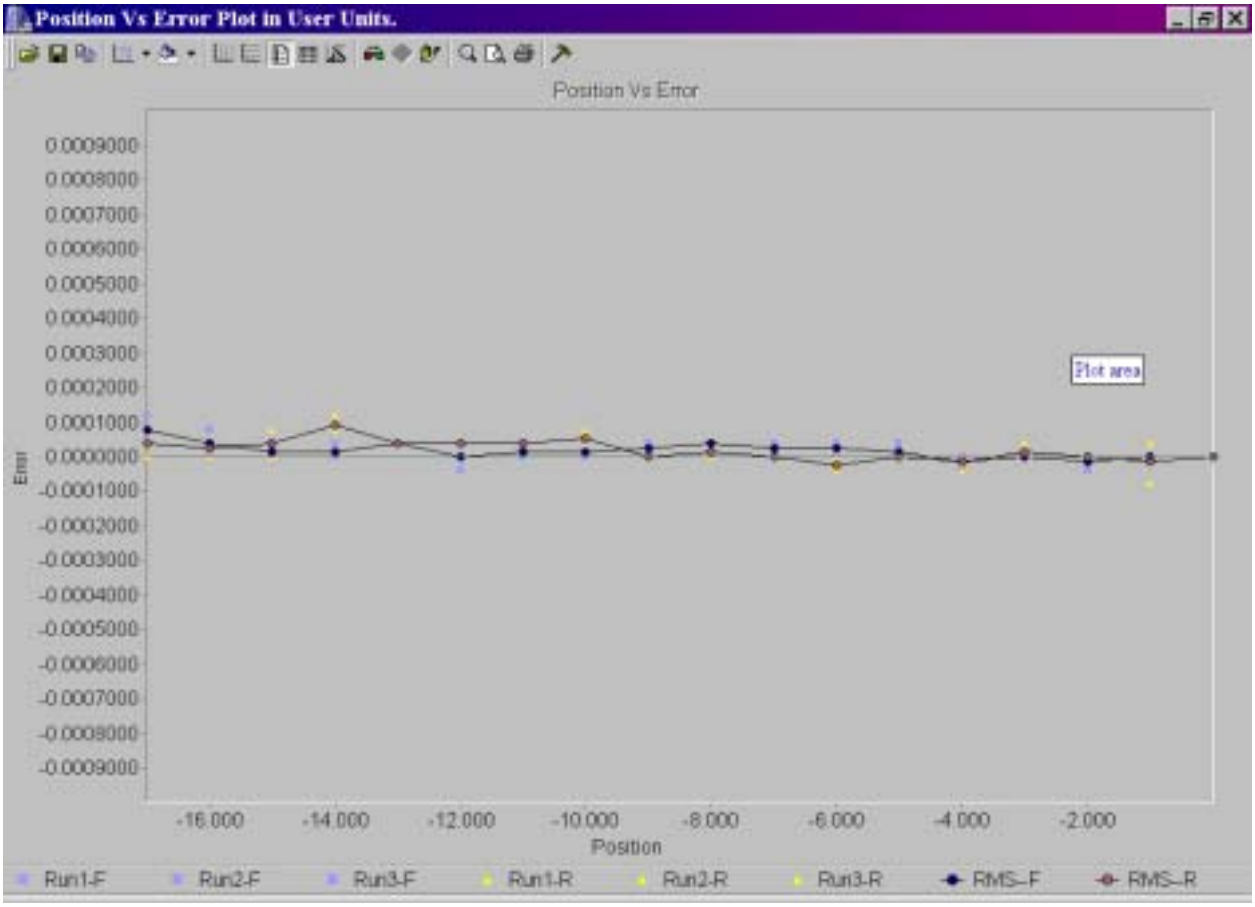
Step 7

Click **Run** to verify Leadscrew and Backlash compensation. The motion program will be executed and data will be collected. On completion, **Program End** will display. At this point, select **Plot Data.**

The following window shows the effect of Leadscrew and Backlash compensation. The forward and reverse data points are very close to each other and to zero. Compare this plot with the previous plot.

Note:

There is an extra point in reverse run at (0,0). This is not a true data collected point. This point is for reference.



A typical Leadscrew table generated from the program will look like:

```
//-----------------------------------------------------------------
//    LeadScrew Compensation Table
//-----------------------------------------------------------------
//   Machine Name : HAAS     Pmac Type : PMAC_TURBO2
//   File Path : C:\Program Files\Delta Tau\HAAS\Axis1_COMP.PMC
//------------------------------Leadscrew Table Definition------------------
#1 DEF COMP  18  2496859
//--------------------LeadScrew Table-------------------
-2213
-1907
-1776
-1791
-1601
-1514
-1281
-1237
-975
-961
-830
-669
-684
-626
-466
-87
0
0
//--------------------Backlash count-------------------
I186 = -902
```

MANUAL LASER COMPENSATION EXECUTION

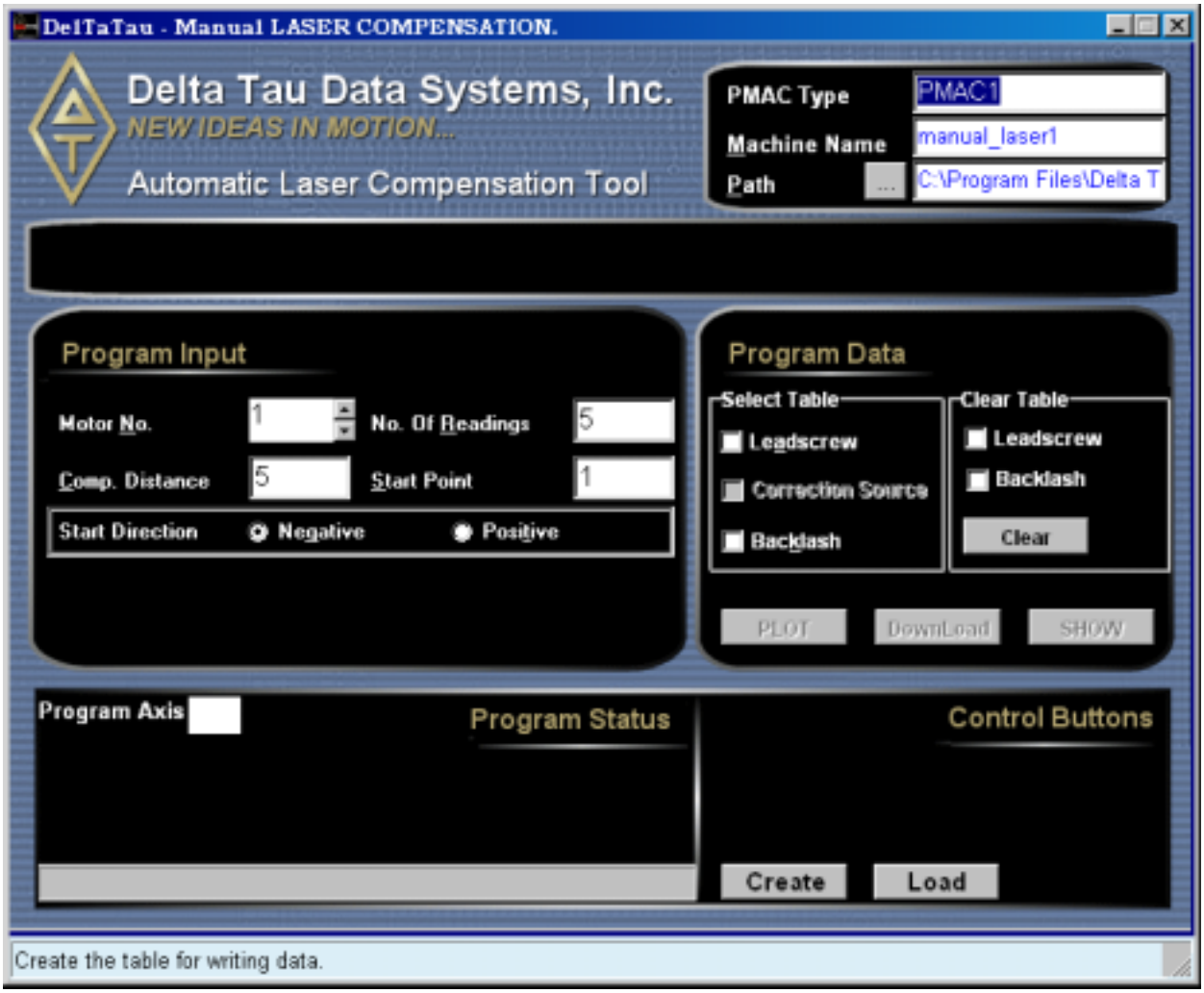
Manual Laser Compensation allows data to be input and plotted manually. Then the compensation table can be created and downloaded.

This option does not need additional wiring or a laser with A QUAD B output.

Main Screen

Highlights

- Navigate through the input by pressing **Tab** or directly select the input by pressing **Alt** and underlined letter.
- Single line help is available when the focus is set to the input field.



Fields

The following outlines the different fields on the main screen.

PMAC Type: This will detect and display the PMAC type automatically. This input cannot be altered. If there is no PMAC, then default PMAC type will be Turbo PMAC 2.

Machine Name: Enter a specific folder name for the application here, if desired. All the files created by the application are stored in this folder. The change can be observed in the Path input. The default name is MyLaser.

Path: The default path to create the Machine Name folder is C:\Program Files \ Delta Tau \<Machine Name>. Browse to change the default path.

Program Input: This group of boxes consists of different input parameters required for the application.

Motor No: Specify the motor number selected for compensation.

Comp Distance: This field specifies the compensation distance from the Start point. The laser reading will be taken on the fly over this distance. Set this distance such that Start Point + comp distance is not greater than total travel available on the machine, otherwise the machine limits will generate fault.

No of Readings: Specify the number of intervals at which the laser reading is taken. For the Turbo PMAC, this limit is 500 points and for Non Turbo, it is 200.

Start Point: Enter the absolute distance from Home position. The compensation readings will start from this point and end at the Start Point + comp Distance. This value should be large enough to accommodate Backlash Take up distance.

Start Direction: This is the direction of the motion. Normally this is opposite of the Homing direction.

Program Data: This group of boxes represents the input set usually after the first data collection run.

Select Table: This group of boxes represents the type of table to be created for the selected motor.

Lead screw: Click to generate the Lead screw compensation table when the download key is clicked.

Correction Source:

Backlash: Click to generate the Backlash compensation table when the download key is clicked.

Clear Table: This group of boxes represents the type of table to be deleted from PMAC for the selected motor.

Lead screw: Click to delete the Lead screw table on Clear key.

Backlash: Click to delete the Backlash table on Clear key.

Plot: Clicking this button will plot the current captured data. The plot can be re-scaled. Plot will enable Download and Show button.

Download: Clicking this button will generate the selected comp tables from the select table and those tables will be downloaded to PMAC. After download, this button will be grayed out until one data collection cycle executes.

Show: Clicking this button will display the current data in tabular form.

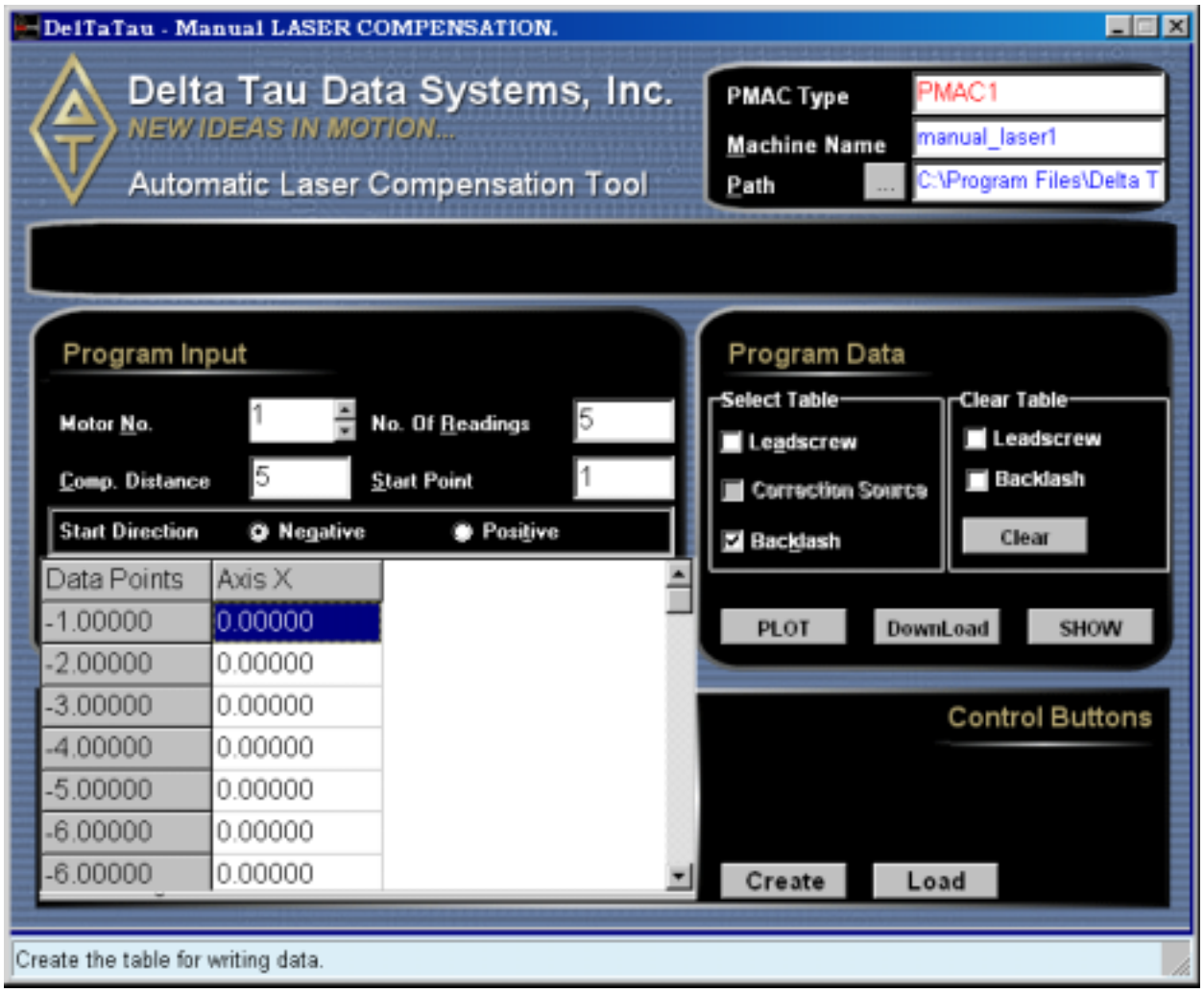
Control Buttons:

Create: Clicking this button will create the data entry table. The table will consider the values in the No. of readings, Comp distance, start point and motor number fields to create the table.

Load: Clicking this button will load the previously saved manual data file. The extension for the file is .LAS file.

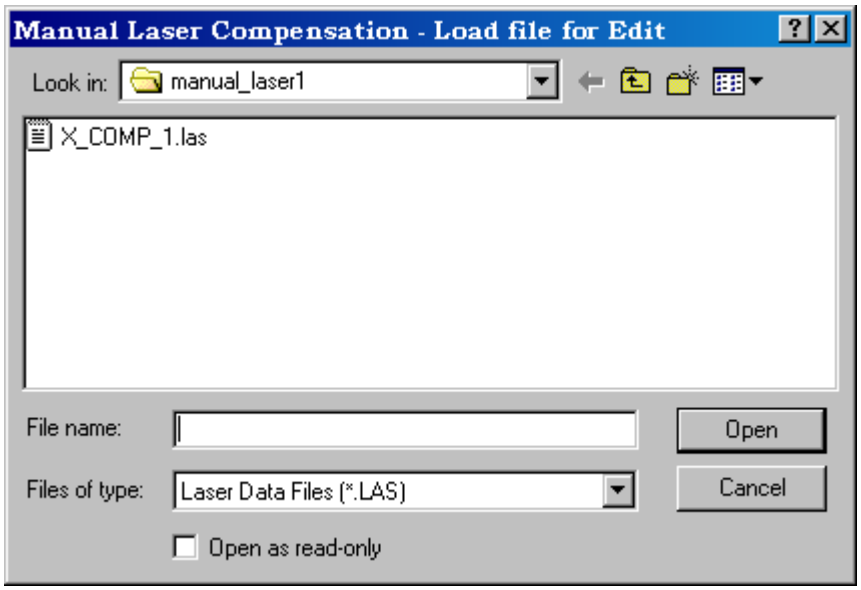
Create Screen

The following screen displays when the Create button is selected.



Load Screen

The following screen displays when the **Load** button is selected.



File Management

The following files are generated from this application in the Path \ Machine Name folder.

Axis<Motor No>_comp.pmc -: Lead screw compensation file for the motor number (e.g. Axis1_comp.pmc).
Axis<Motor No>_blcomp.pmc -: Backlash compensation file for the motor number (e.g. Axis1_blcomp.pmc).
<Axis Char>_comp_<repeat counter>.txt -: Data collection file (e.g. X_comp_1.txt).
<Axis Char>_RMS_<Motor No>.txt -: Tabular data display file (e.g. X_RMS_1.pmc).
Axis<Motor No>_comp.las -: Compensation data file for the motor number (e.g. X_COMP_1.las).

Executing Manual Laser Compensation

To execute the compensation program manually, complete the following steps:

Start the application and select **Manual** laser compensation. The Manual Laser Compensation Dialog box displays.

Step 1

Clear the tables from the PMAC by selecting the tables in **Clear Table** group and select the **Clear** button.

Step 2

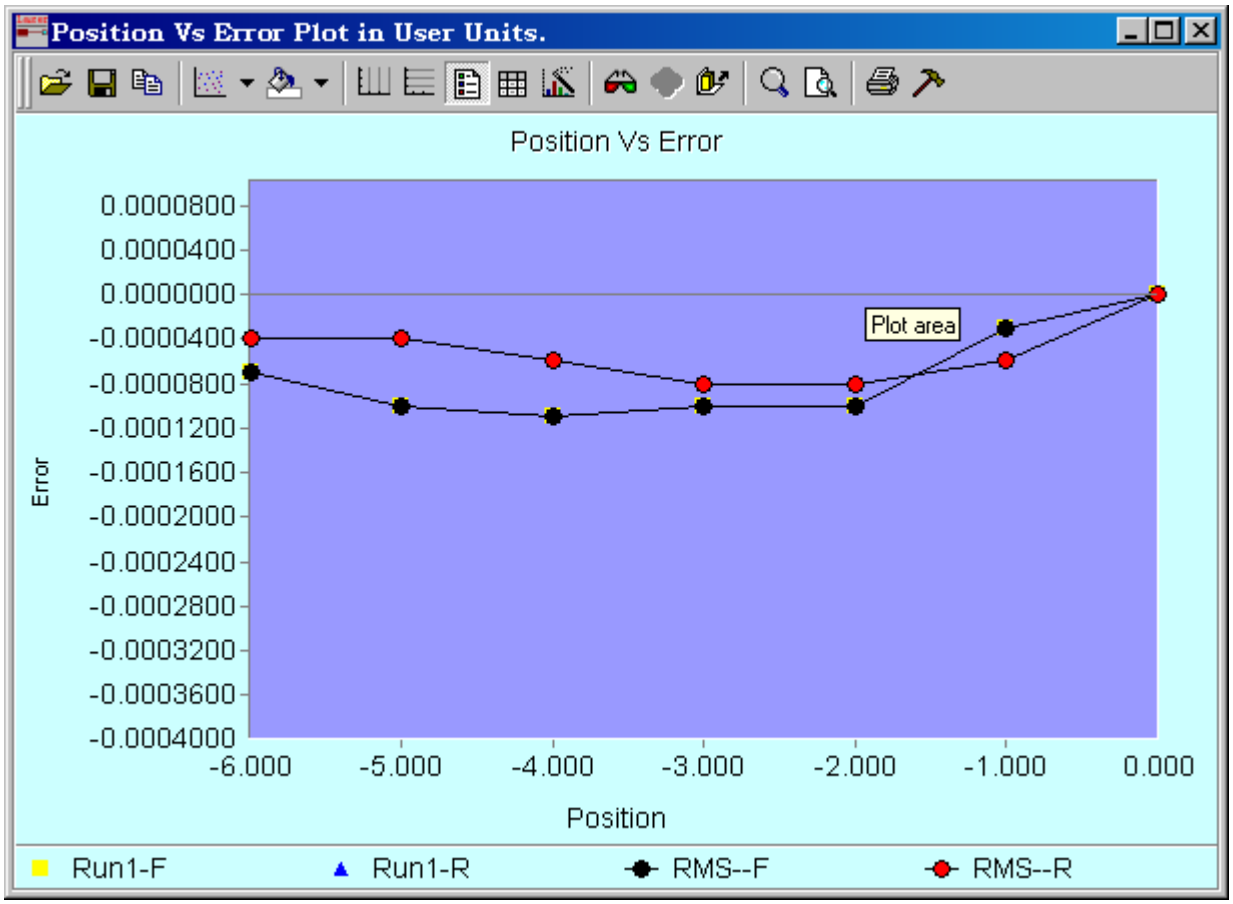
Set the **Program Input** group.

1. The compensation is for **Motor No** 1.
2. The distance to be compensated is (**Comp. Distance)** 5 inches and **No. Of Readings** are 5. Thus, the readings are taken at every inch.
3. The first data point is at 1 inch (**Start Point**).
4. Set the compensation **Direction** to negative.
5. Click the **Create** button to create the blank table ready for data entry. The table has two columns, Data Points and Axis <* >. The Axis character will be displayed by reading the coordinate system definition from the PMAC. Initially, the Axis column will be set with zeros.
6. Measure the laser equivalent of one inch and enter the reading in the AXIS column.

Data Entry Screen

Click **Plot** to display the Position Vs Error plot for the current Run.

> ***Note:***
>
> There is an extra point in reverse run at (0,0). This is not a true data point. This point is for the reference.



1. Select the type of compensation from the **Select Table** Group and click the **Download** button. This will generate and download the selected table. The Leadscrew, Backlash or both can be selected for download.
2. Set the **Compensation On (I50 = 1)** flag in the PMAC using the Executive program and then take another set of readings to check effect of the compensation.

This program allows appending of the Leadscrew and backlash table. If the table exists already for the same number of points and distance, then the new calculated values are appended to the existing table.